Development of PLC in Sumitomo Electric

March, 2004
Sumitomo Electric Industries, Ltd.
Application of PLC (Distribution Line)

Internet
VoIP
(Video streaming)

Installation example
Application of PLC ②
(In Building)

Apartment Houses / Hotel

PLC transmits the data from the PLC, optical fiber or microwave to each room, each plug

Internet
VoIP
(Video streaming)
Application of PLC ③ (In House)

No need of wiring
Home LAN formed by PLC through ADSL or FTTH
Home automation is available

Access line (ADSL, CATV, Fiber)
Application of PLC ④ (Rural Area)

Long distant overhead line needs several Repeaters

Optical Fiber

Substation 138/4-12kV

Repeater

Distribution Line (4 – 12kV)

Pole Tr

Repeater

240/120V (Low Voltage)

CPE

CPE

CPE
Avoidance of Interference due to Radiation

Power lines could be an antenna $\rightarrow$ electric field radiation

Possible interference with other wireless equipment

Low frequency PLC

AM radio

Radio-Amateur, Short-wave radio bands

OFDM

Easy to avoid the Radio-Amateur and the Short-wave radio bands
**Power Masking with OFDM Technology**

<table>
<thead>
<tr>
<th>Principle of Modulation</th>
<th>OFDM (Orthogonal Frequency Division)</th>
<th>SS (Spread Spectrum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carriers&lt;br&gt;Data stream divided in a lot of orthogonal carriers. Efficient use of frequency band → high speed transmission</td>
<td><img src="image" alt="OFDM Spectrum" /></td>
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<td>[●](Spectrum mask)</td>
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**How to avoid interference with the existing RF band**

Existing RF band (radio amateurs etc.)

No use of these carriers

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**Principle of Modulation**

- **OFDM (Orthogonal Frequency Division)**: Carriers
  - Data stream divided in a lot of orthogonal carriers. Efficient use of frequency band → high speed transmission

- **SS (Spread Spectrum)**: Tx signal spread by SS modulation
  - Tx Signal → Signal on power line Rx Signal

**Avoidance of existing RF band**

- ○ (Spectrum mask)
- × (Need filters)
## PLC Products Lineup (45Mbps)

### Sample HE/Repeater Specification

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<td>Modulation</td>
<td>OFDM</td>
</tr>
<tr>
<td>Number of Carriers</td>
<td>1280 (Programmable)</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>2.5MHz～11.8MHz (LINK1)</td>
</tr>
<tr>
<td></td>
<td>13.8MHz～22.8MHz (LINK2)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>6.3MHz (Upstream : 2.5MHz Downstream : 3.8MHz)</td>
</tr>
<tr>
<td>Data Rate</td>
<td>45MbpsMax. (Upstream : 18Mbps Downstream : 27Mbps)</td>
</tr>
<tr>
<td>Multi-Access Method</td>
<td>TDMA—FDD</td>
</tr>
<tr>
<td>Transmission Power</td>
<td>−40dBm/Hz Max.</td>
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### Sample VoIP CPE Specification

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## Sample 200Mbps PLC Modem Spec

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<tr>
<td>Modulation Method</td>
<td>OFDM</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>2 - 30MHz (Selective)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Approx. 30MHz</td>
</tr>
<tr>
<td>Data Rate (Physical layer rate)</td>
<td>200Mbps Max.</td>
</tr>
<tr>
<td>Multi-Access Method</td>
<td>Master Slave or CSMA</td>
</tr>
<tr>
<td>Transmission Power</td>
<td>-50dBm/Hz Max.</td>
</tr>
</tbody>
</table>
Desired Features of 200Mbps PLC Modem

• **Performance:**
  - Maximum speed up to 200 Mbps, thanks to:
    • High-density, high-efficiency OFDM modulation.
    • > 100 Mbps FTP transfer
    • > 25 simultaneous VoIP calls per LV transformer
  - 100% coverage in each house

• **Plug-and-Play:**
  - Ready to use out of the box (no configuration needed by end-user for normal usage).

• **Compact size/Low cost:**
  - Additional parts around a chip reduced
  - No CPU board and fan needed
• **Flexibility:**
  
  – Suited for **home-networking** and **access**
  
  – Programmable frequency bands (10, 20 or 30 MHz, from 1 to 34 MHz)
  
  – Supports master/slave and peer-to-peer architectures
  
  – Support time-division and frequency-division coexistence between access & in-home
  
  – Designed to work in multi-dwelling units, hotels, office buildings, airports, etc.
  
  – Programmable QoS architecture and strict bandwidth/latency reservation